Completed Project (2011 - 2014)

Composite Cryotank Technologies and Demonstration (CCTD) Project

Game Changing Development Program | Space Technology Mission Directorate (STMD)

ABSTRACT

Advance the technologies for composite cryogenic propellant tanks at diameters suitable for future heavy lift vehicles and other in-space applications with a goal of reducing weight and cost.

ANTICIPATED BENEFITS

To NASA funded missions:

A high confidence for CCTD technology infusion into SLS Exploration Upper Stage, commercial and other government applications.

DETAILED DESCRIPTION

Switching from metallic to composite construction holds the potential to dramatically increase the performance capabilities of future space systems through a dramatic reduction in weight. A potential initial target application for the composite technology is an upgrade to the upper stage of NASA's Space Launch System heavy-lift rocket.

2.4-meter diameter Tank Test Summary

Built by Boeing at their Tukwila, Wash., facility, the tank arrived at NASA in late 2012. On June 25, 2013 at NASA MSFC, the 2.4m diameter all-composite cryogenic tank was successfully pressure tested. The test met all requirements: stepwise fill with liquid hydrogen (–423 °F) to 90% volume capacity followed by pressurizing the tank to 135 psig. The 2.4m tank was then cycled through 20 pressure/vent cycles, measuring hydrogen gas permeation on the tank dome.

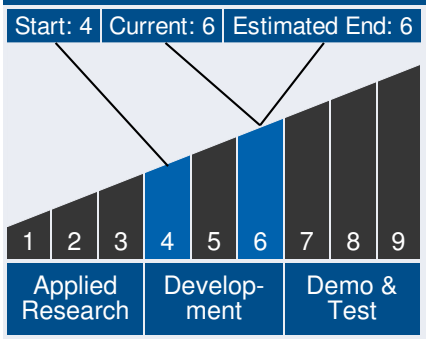
5.5m Tank Test Summary

NASA's Super Guppy, a wide-bodied cargo aircraft, landed at the Redstone Army Airfield near Huntsville, Ala. on March 26, 2014 and since then NASA has completed a demanding series

5.5m Tank Model

Table of Contents

Technology Maturity



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of tests inside the test stand at MSFC. Engineers added structural loads to the tank to replicate the physical stresses launch vehicles experience during flight.

In other tests, the tank successfully maintained fuels at extremely low temperatures and operated at various pressures. Engineers filled the tank with almost 30,000 gallons of liquid hydrogen chilled to –423 °F, and repeatedly cycled the pressure between 20 to 53 pounds per square inch – the pressure limit set for the tests.

These successful tests marked an important milestone on the path to demonstrating the composite cryogenic tanks needed to accomplish the next generation of deep space missions. This investment in game changing space technology will help enable NASA's exploration of deep space while directly benefiting American industrial capability in the manufacturing and use of composites.

Additional Information:

In September 2011, NASA awarded Boeing the contract to design, manufacture and test two lightweight composite cryogenic propellant tanks.

CCTD was an agency-wide effort with Marshall Space Flight Center (MSFC) leading project management, manufacturing & test, Glenn Research Center (GRC) leading the materials, and Langley Research Center (LaRC) leading structures effort for this project. Significant contributions from LaRC & GRC loads/stress personnel contributed to the understanding of thermal/ mechanical strain response while undergoing testing at cryogenic temperatures. The project finalized in September 2014.

The composite tank project provided a great deal of experience and improved confidence in utilizing composites and therefore is changing the way we look at composites for spacecraft applications.

Management Team

Program Executive:
- Ryan Stephan

Program Manager:
- Stephen Gaddis

Project Manager:
- John Vickers

Principal Investigator:
- Peter Lillehei

Technology Areas

Primary Technology Area:
Materials, Structures, Mechanical Systems and Manufacturing (TA 12)

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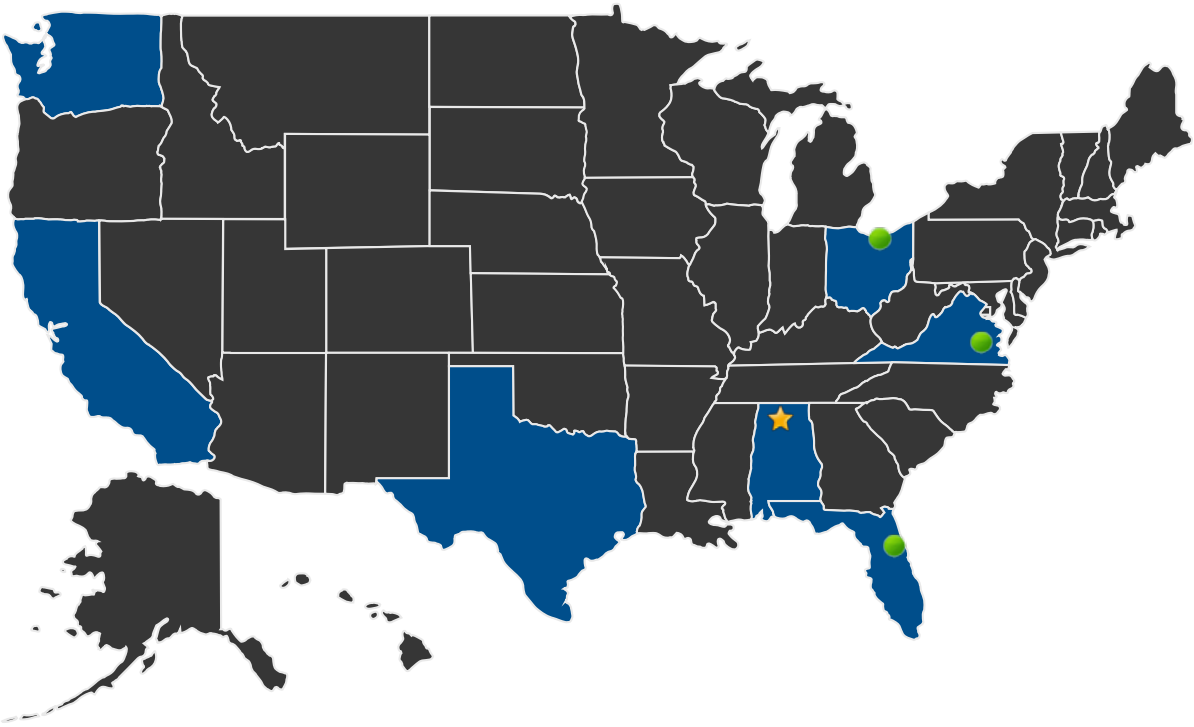
U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Marshall Space Flight Center

Supporting Centers:

- Glenn Research Center
- Kennedy Space Center
- Langley Research Center

Contributing Partners:

- Boeing

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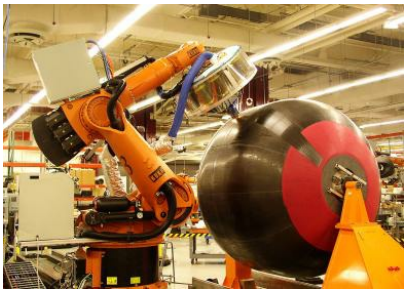
IMAGE GALLERY

2.4m Composite Cryotank



2.4m Composite Cryotank during AFP

5.5m Composite Cryotank Arrives at MSFC for inspection

DETAILS FOR TECHNOLOGY 1

Technology Title

Composite Cryotank Technologies and Demonstration (CCTD)

Technology Description

This technology is categorized as a hardware component or part for ground scientific research or analysis

Switching from metallic to composite construction holds the potential to dramatically increase the performance capabilities of future space systems through a dramatic reduction in weight. A potential initial target application for the composite technology is an upgrade to the upper stage of NASA's Space Launch System heavy-lift rocket.

Capabilities Provided

Composite structures hold the potential to dramatically increase the performance capabilities of future space systems through a dramatic reduction in weight and increase affordability.

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Potential Applications

The project advanced technologies for composite cryogenic propellant tanks at diameters suitable for future heavy lift vehicles and other in-space applications. Applications include a potential upgrade to the upper stage of NASA's Space Launch System heavy-lift rocket, commercial launch applications, and in-space applications.